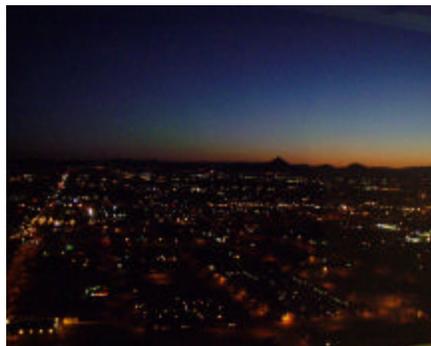




***Modeling Ozone Budgets -
with a Special Emphasis on Phoenix 2001:***

***The Role of Transport, Chemical Production,
and Deposition***

*Cynthia Atherton, Dan Bergmann, Philip Cameron-Smith, Peter Connell,
Jane Dignon, Al Franz, Chuck Molenkamp, Doug Rotman, John Tannahill*



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With special thanks to colleagues at Argonne, PNNL, Batelle, ADEQ, BNL, UW

We use our global model, IMPACT, to help interpret data from Phoenix 2001



The reason



The timing



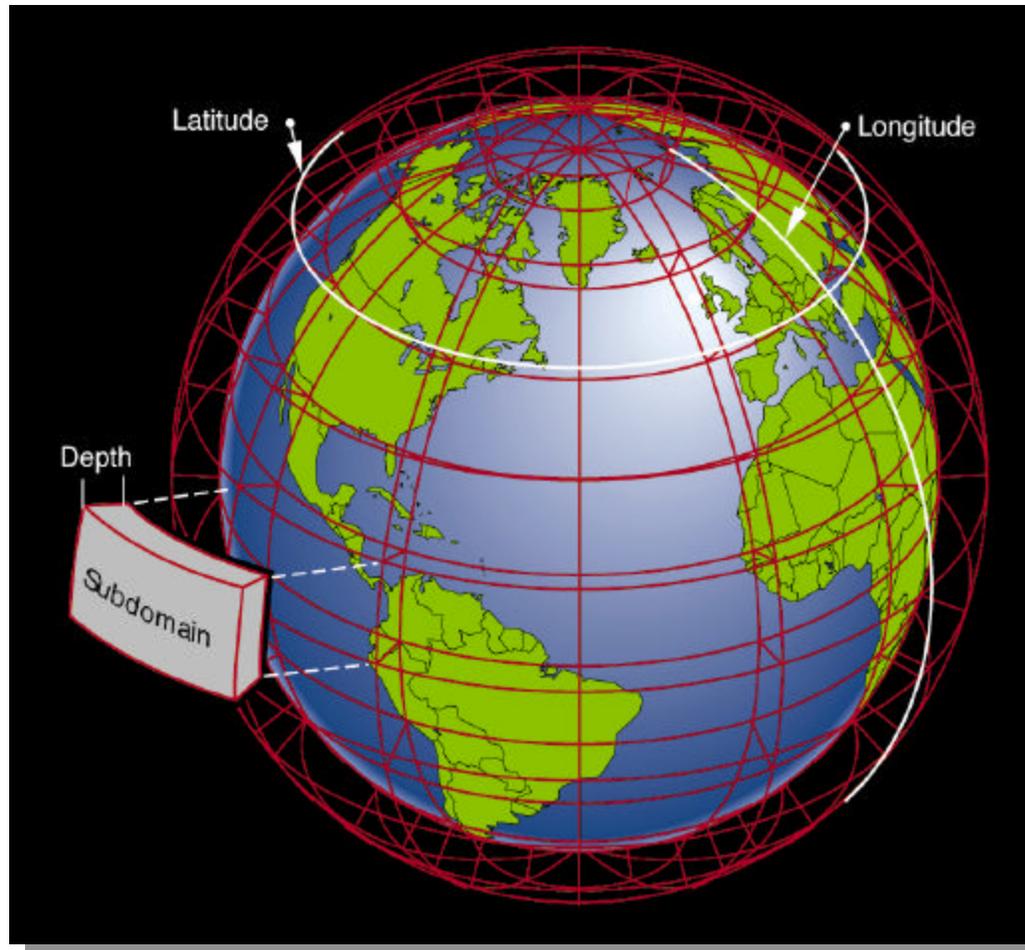
HC sampling - Bank One



*Sondes-
Vehicle Lab*



IMPACT contains a full prognostic troposphere AND stratosphere and runs on parallel computers



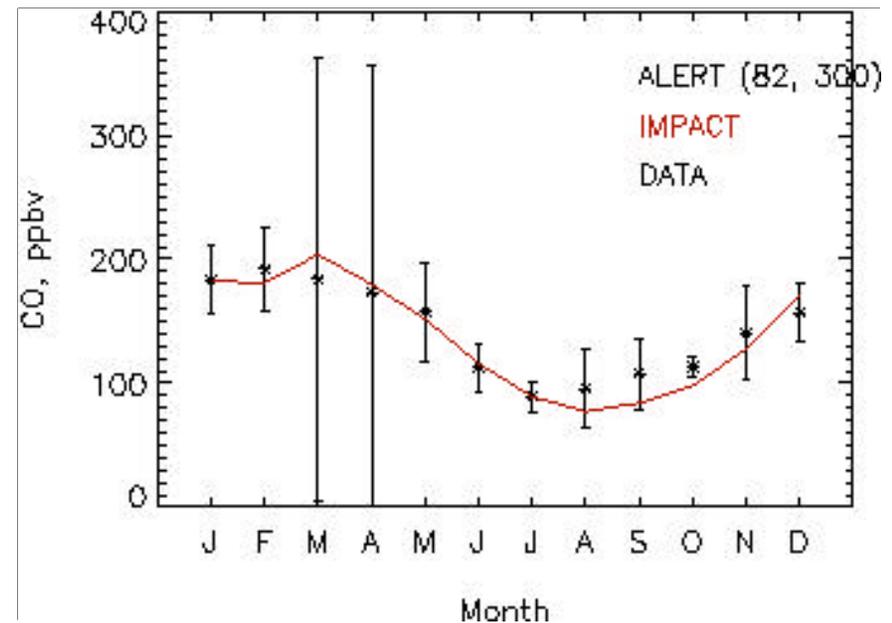
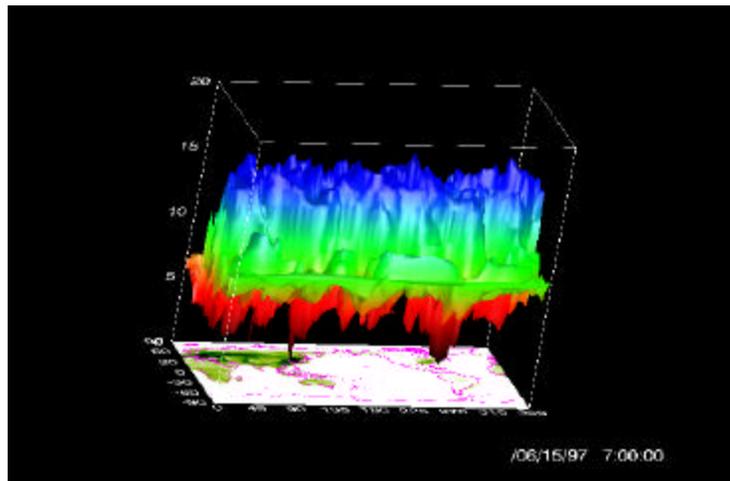
- **Processes:** Chemistry, photolysis, advection, diffusion, wet & dry deposition
- **Species:** CO, CH₄, NO, NO₂, OH, O₃, C₅H₈, PAN, HNO₃, C_xH_y, BrO, ClO, (etc...to > 200)
- **Meteorology:**
Assimilated or GCM
- **Resolution:**
Met. driven
(2° x 2.5° here)



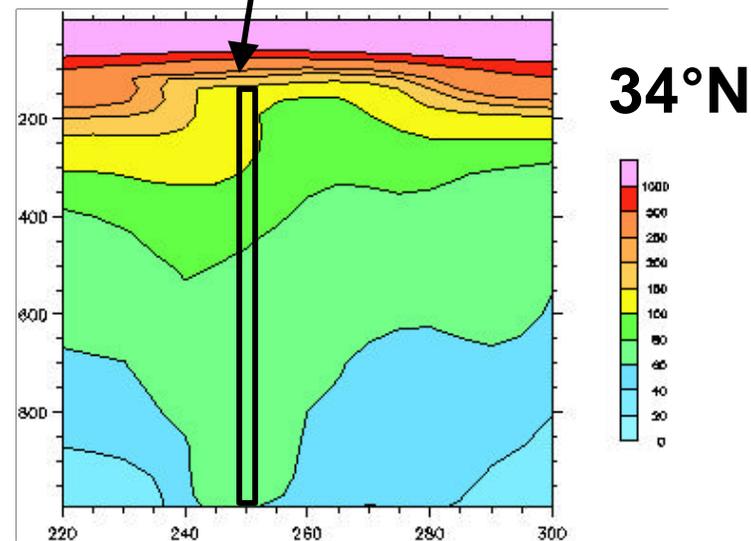
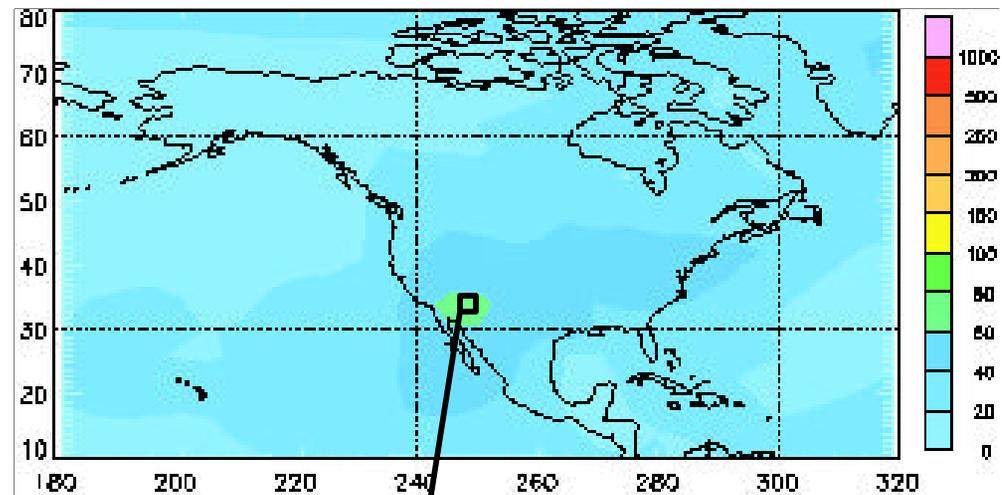
Input meteorological fields can vary

NASA/DAO_GEOS3 (Assimilated)
Particular historical set of dates
2001<--> Phoenix

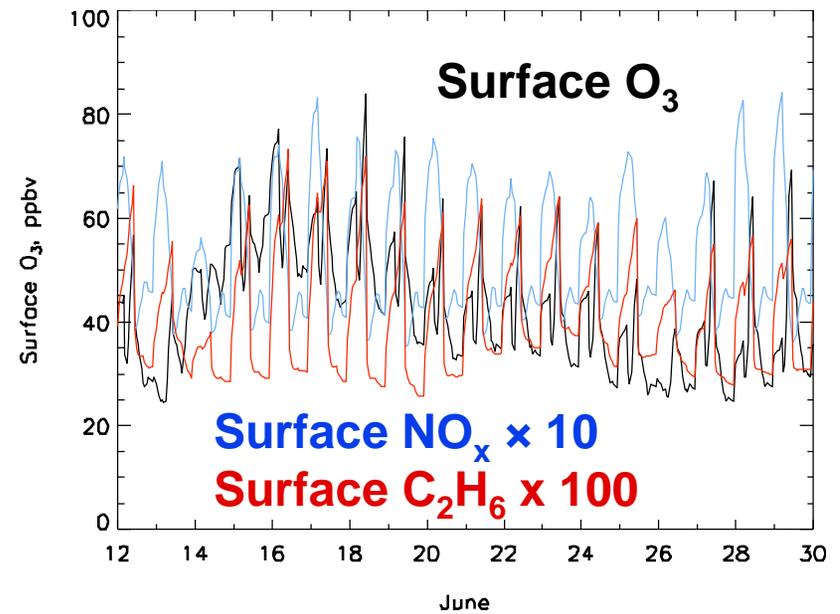
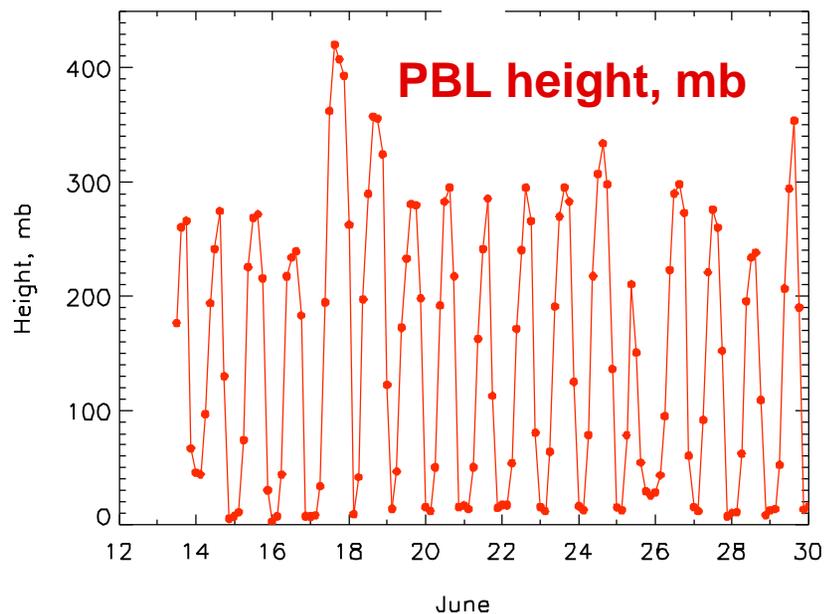
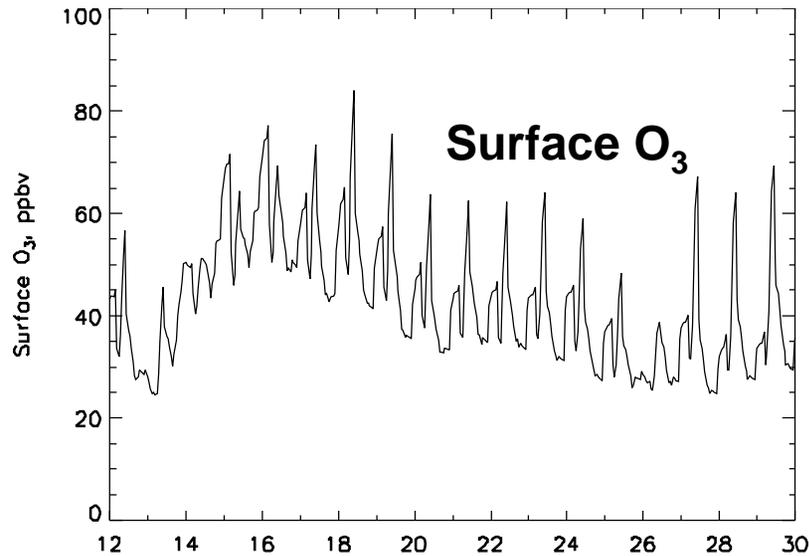
MACCM3 (General Circulation Model)
Climatological Average
(e.g. a perpetual month)



We examine a column around Phoenix ($2^\circ \times 2.5^\circ \times \sim 14\text{km}$)

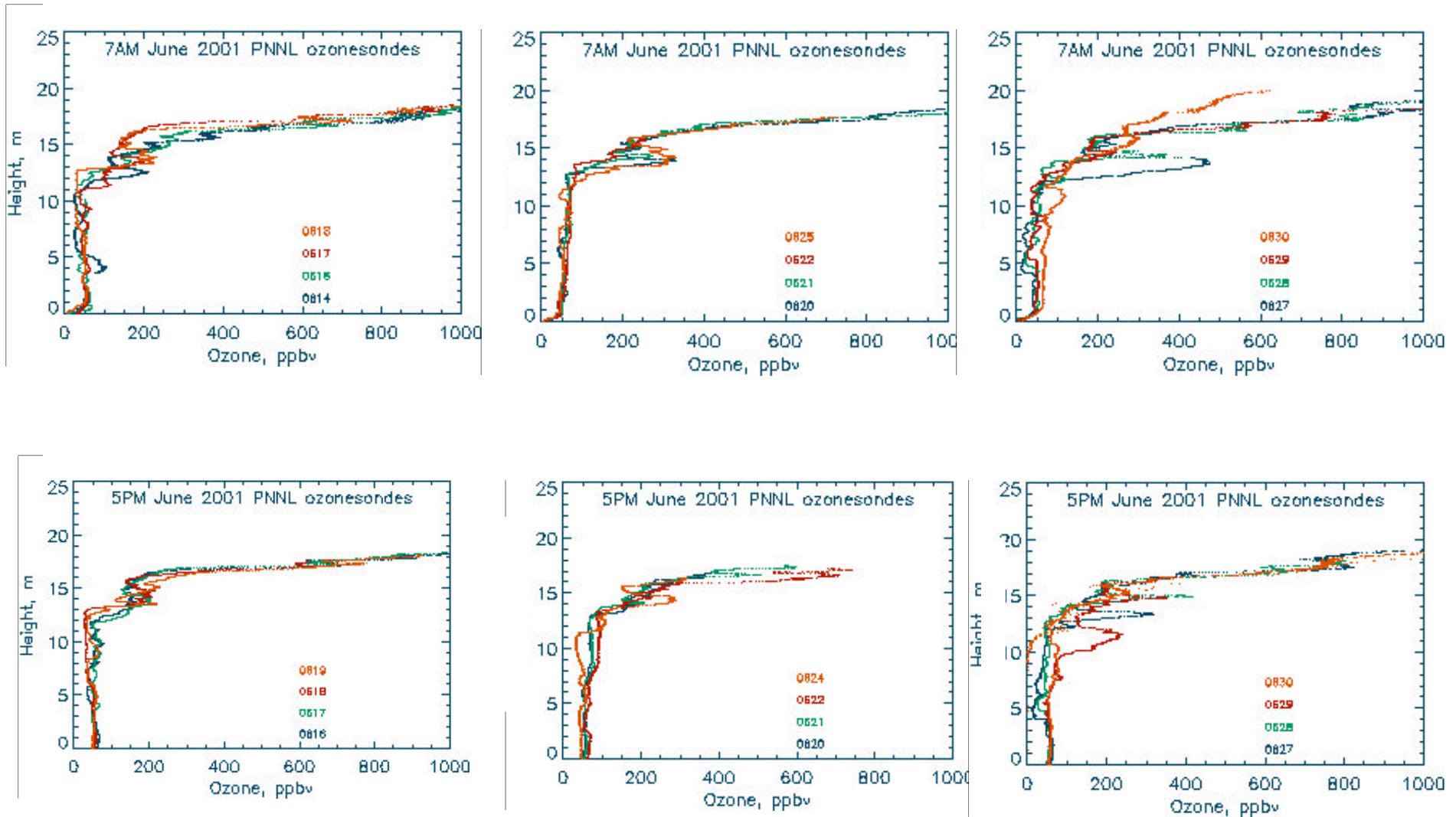


IMPACT shows daily variation in PBL, O₃, NO_x, C₂H₆ for June 2001



Other species, other levels,
upwind conditions, elevated
conditions, etc....

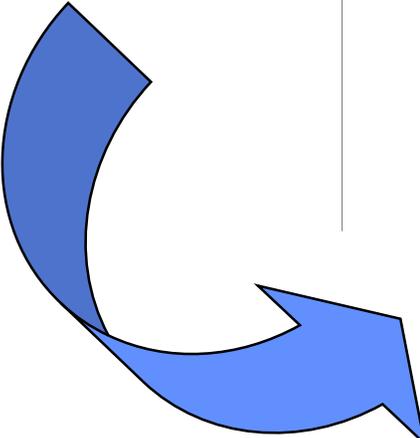
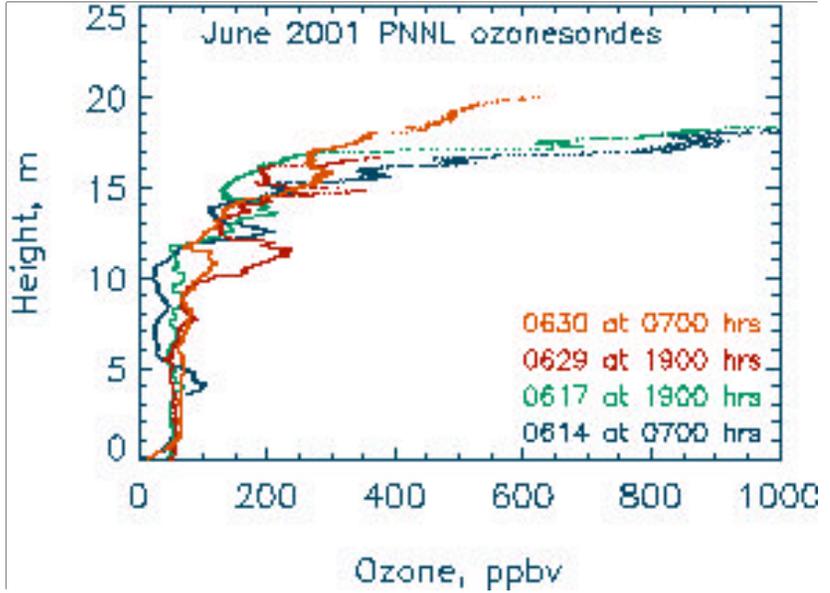
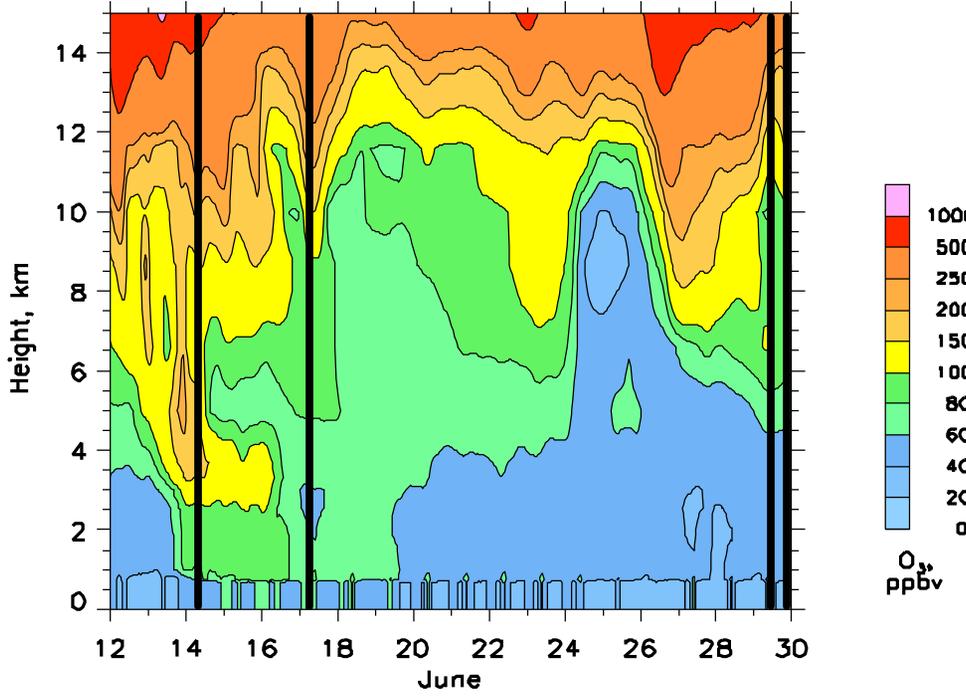
PNNL* ozonesondes (June 2001) show day-to-day variation



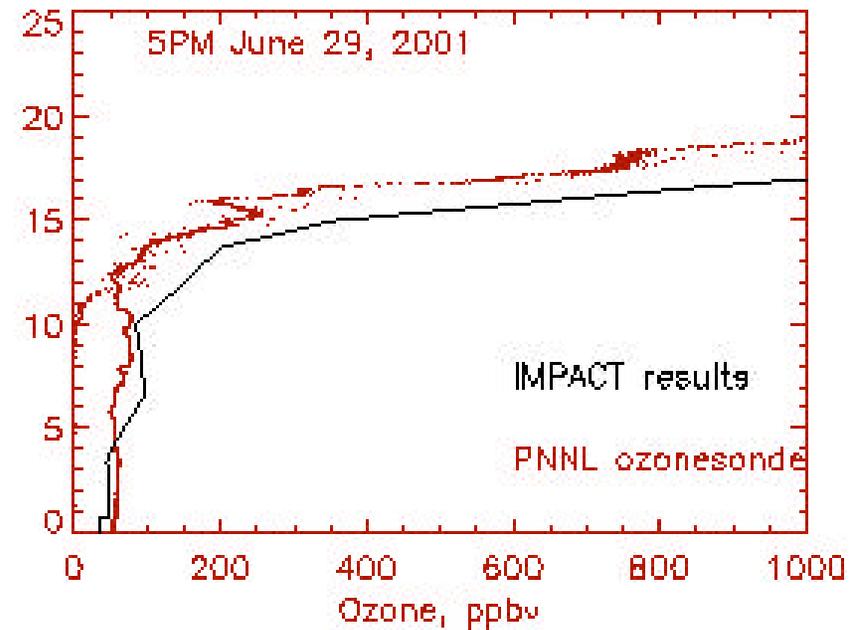
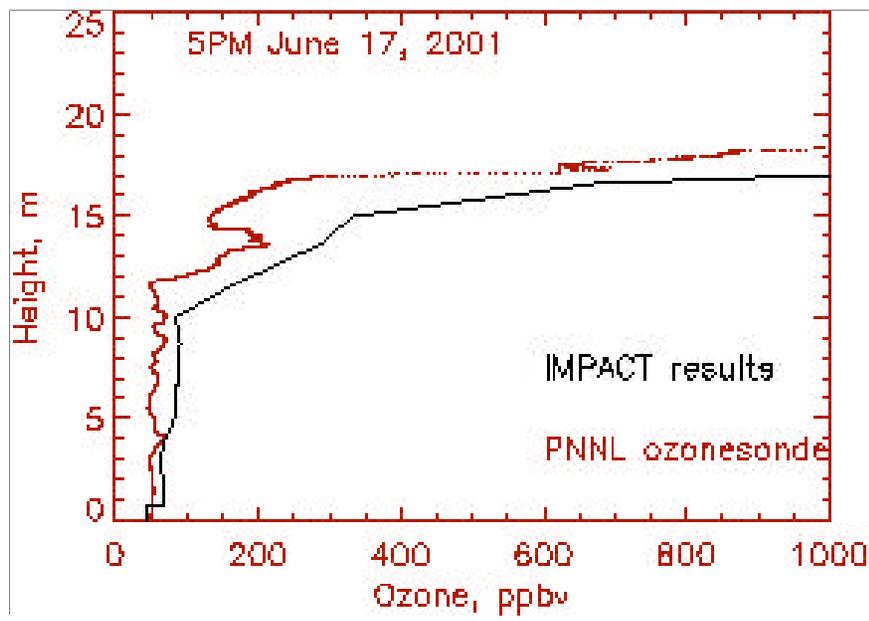
*With thanks to Jerome Fast



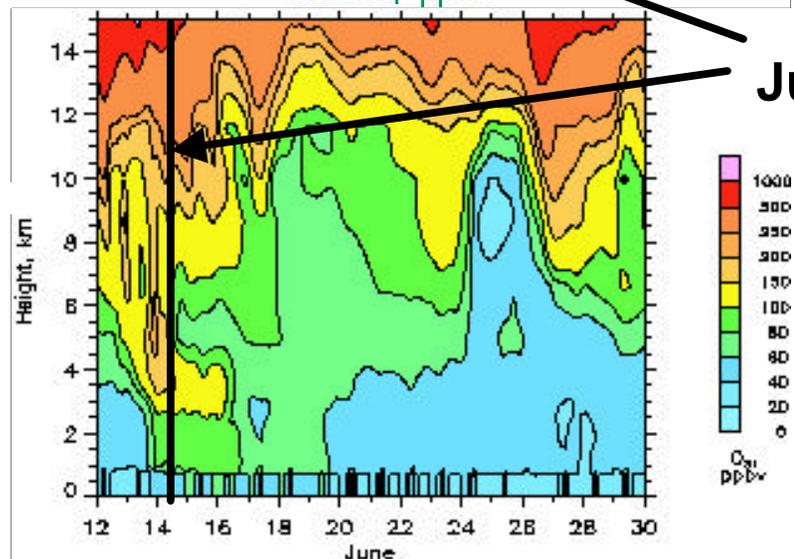
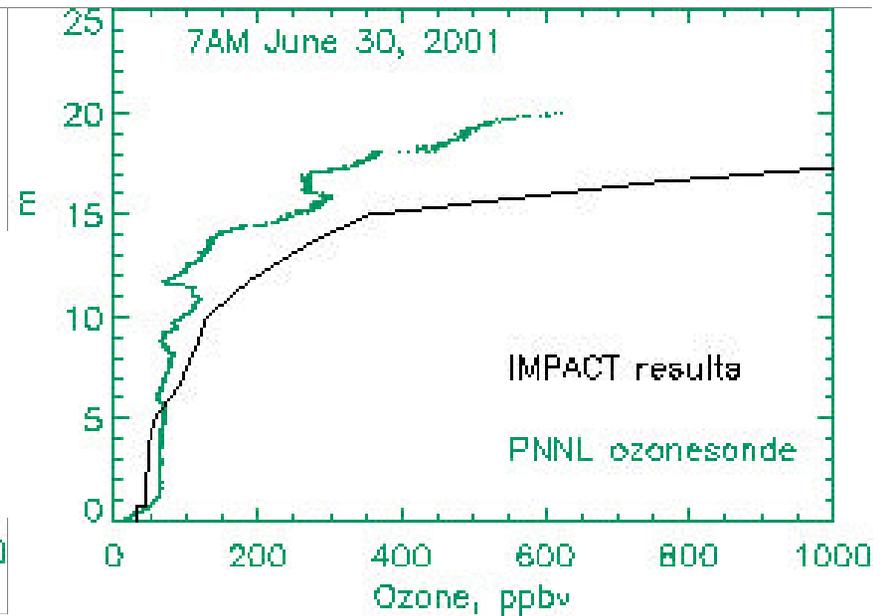
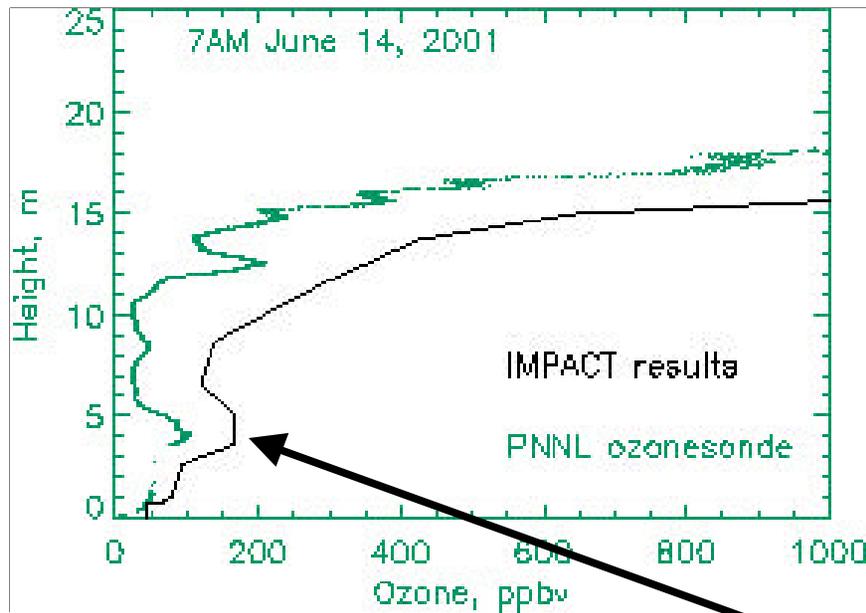
We examine four days: 6/14, 6/17, 6/29, 6/30



IMPACT results and PNNL ozonesondes show similar structure



IMPACT results and PNNL ozonesondes show similar structure

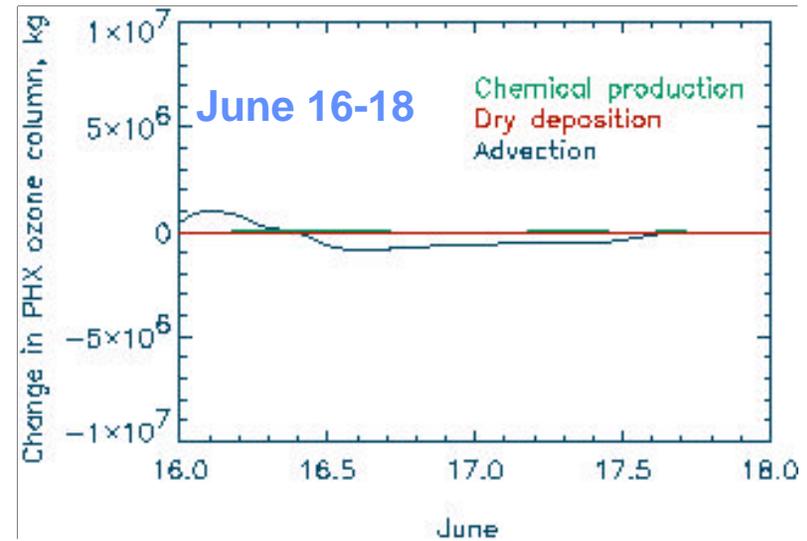
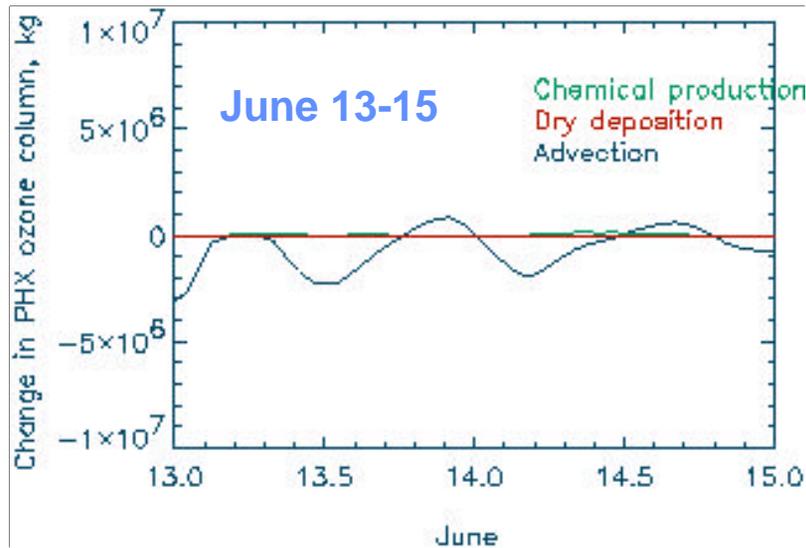
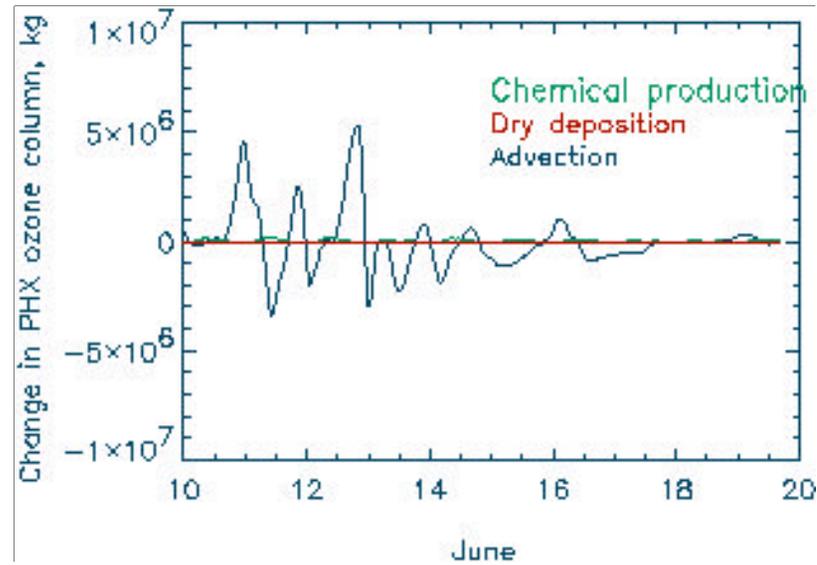


June 14

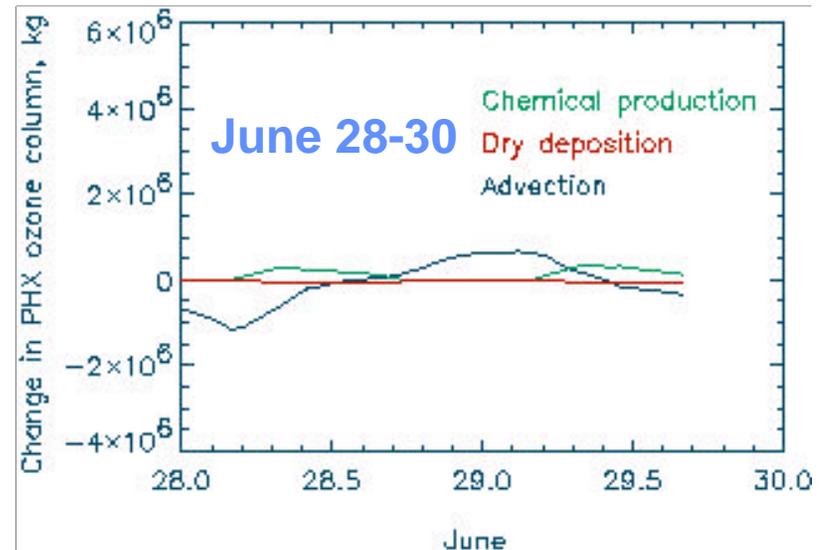
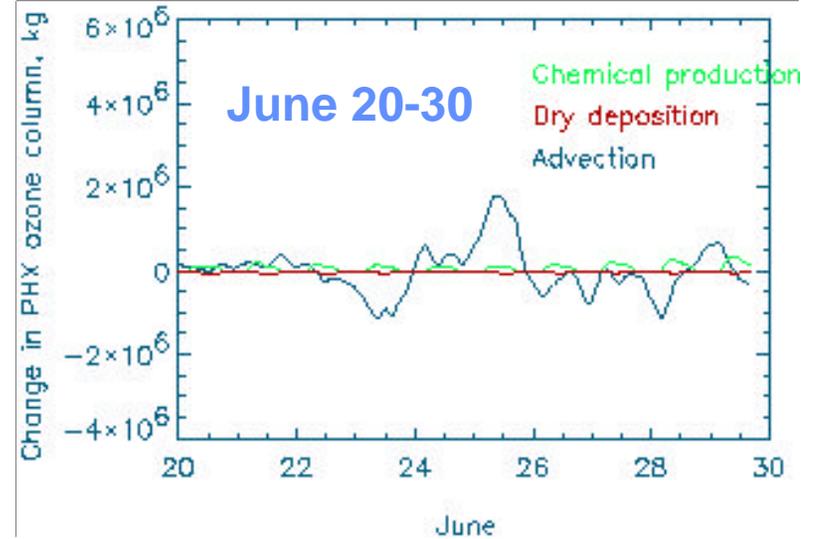
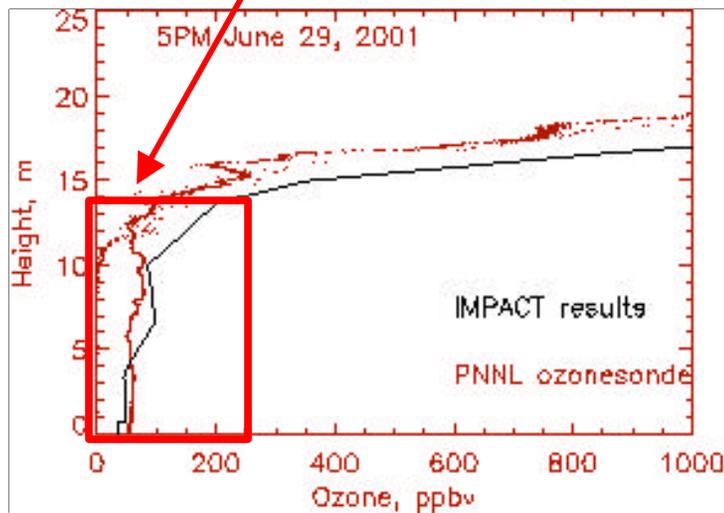
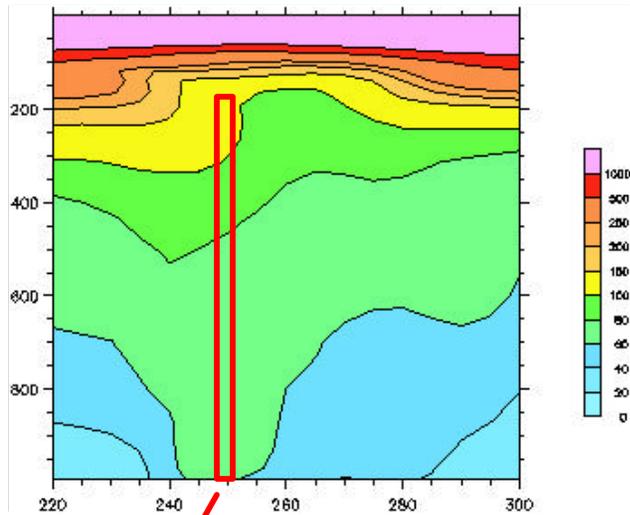


IMPACT shows the O₃ budget for the Phoenix column

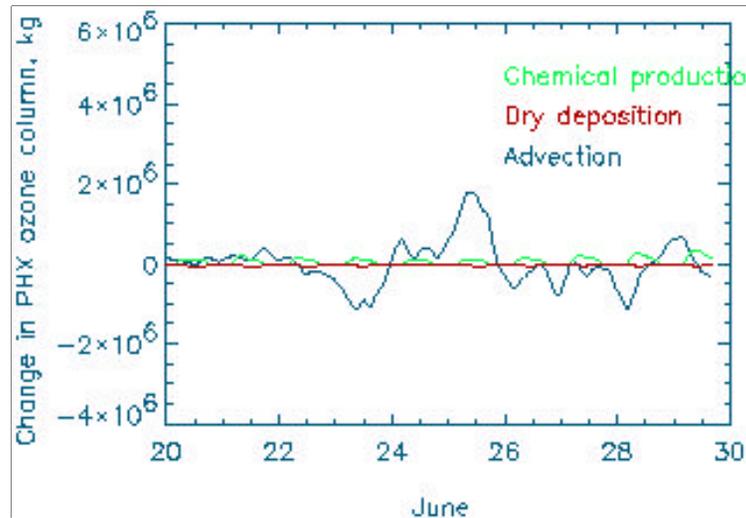
June 10-20, 2001



Advection is important in the tropospheric ozone budget because of the height of the “Phoenix column”

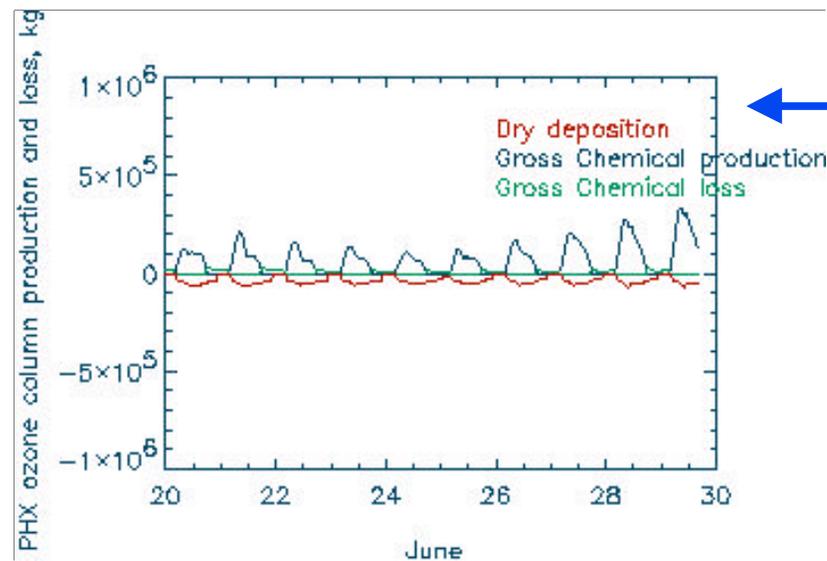


Net ozone production is the sum of “gross production” and “gross loss”



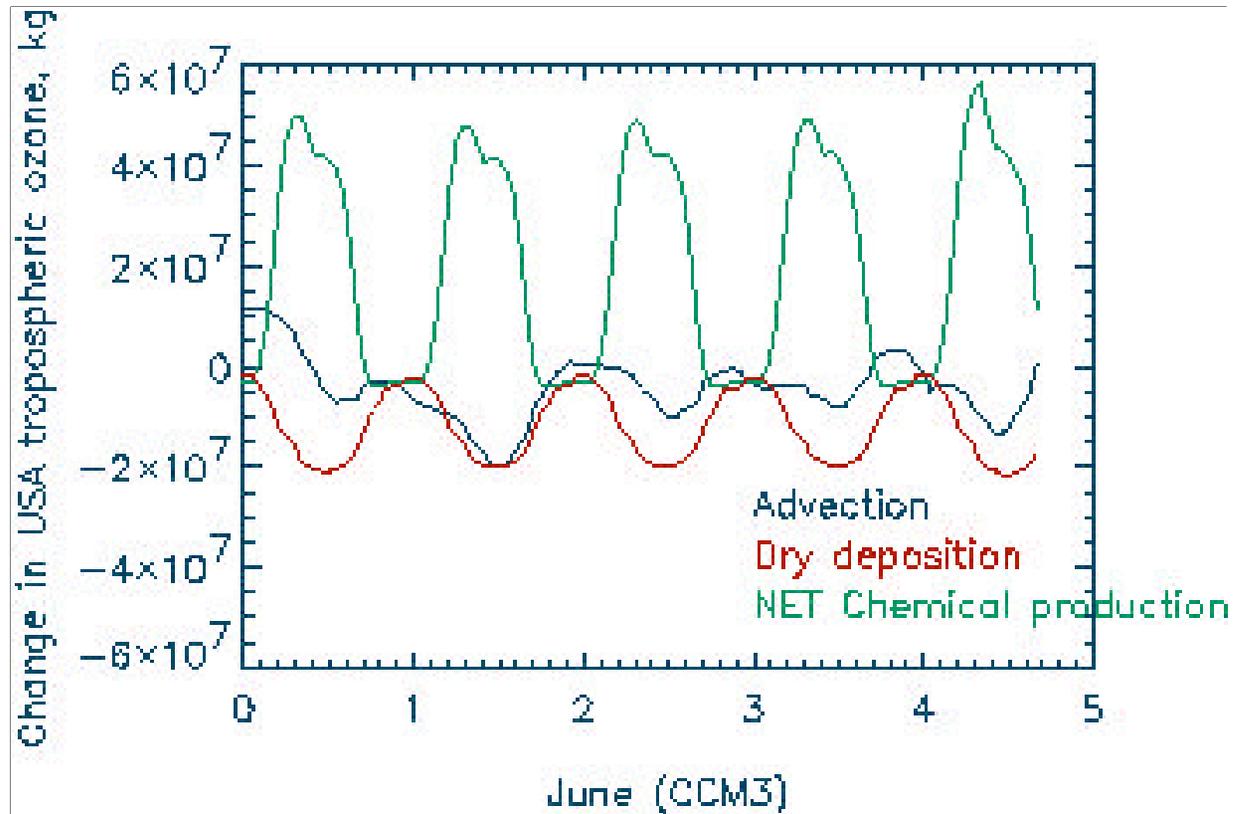
← NET

arises
from



← GROSS

We are also studying tropospheric O₃ budgets for larger regions



The LLNL IMPACT global model provides useful information for specific and GCM-average time periods



- >200 chemical species
- We use assimilated meteorology to simulate specific time periods
- Model ozonesondes compare well to Phoenix 2001 observations
- Model predicts surface and elevated O₃ (NO_x, HCs, etc.):
 - Chemical production/loss
 - Advection
 - Deposition
- Future work:
 - Have implemented aerosol capabilities; evaluation required & ongoing
 - Consider issues of aerosol impacts on budgets: HO_x, NO_x, NO_y, O₃
 - Examine energy use changes on key species (budgets, concentrations, etc.)

A special thanks to our field work colleagues...

